

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Kinosternon sonoriense longifemorale*

COMMON NAME: Sonoyta mud turtle

LEAD REGION: Region 2

INFORMATION CURRENT AS OF: April 2010

STATUS/ACTION

☐ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date:

☐ 12-month warranted but precluded - FR date:

☐ Did the petition requesting a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

Higher priority listing actions, including court-approved settlements, court-ordered statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the Sonoyta mud turtle. We continue to monitor Sonoyta mud turtle populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR provides information on listing actions taken during the last 12 months.

☐ Listing priority change

Former LP: ☐

New LP: ☐

Date when the species first became a Candidate (as currently defined): Sept. 19, 1997

☐ Candidate removal: Former LP: ☐

☐ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

☐ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

☐ F – Range is no longer a U.S. territory.

- ☐ I – Insufficient information exists on biological vulnerability and threats to support listing.
- ☐ M – Taxon mistakenly included in past notice of review.
- ☐ N – Taxon does not meet the Act’s definition of “species.”
- ☐ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Reptile, Kinosternidae (Mud and Musk Turtles)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:

Arizona and Sonora, Mexico

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Pima County, Arizona and Sonora, Mexico

LAND OWNERSHIP: In the United States, 100% of the Sonoyta mud turtle’s habitat is owned by the National Park Service, Organ Pipe Cactus National Monument (OPCNM). The pond at Quitobaquito is roughly 0.22 hectares (ha) (0.54 acres (ac)). The addition of the springs makes for a total of approximately 0.24 ha (0.6 ac) of aquatic environment. The land area that contains that aquatic environment is roughly 8 ha (20 ac), which is all part of OPCNM. Acreage in Mexico is variable and no ownership information is available.

LEAD REGION CONTACT: Sarah Quamme, 505-248-6419, Sarah_Quamme@fws.gov

LEAD FIELD OFFICE CONTACT: Erin Fernandez, Arizona Ecological Services Field Sub-office, Tucson, 520-670-6150 x238, Erin_Fernandez@fws.gov

BIOLOGICAL INFORMATION

Species Description

The Sonoyta mud turtle (*Kinosternon sonoriense longifemorale* Iverson 1981) is an isolated endemic subspecies with a small distribution along the United States/Mexico international border in southwestern Arizona and northwestern Sonora. The Sonoyta mud turtle is a dark, medium-sized (carapace length to 14.5 centimeters (cm) or 5.7 inches (in)), aquatic turtle with a mottled pattern on the head, neck, and limbs. The upper shell (carapace) is olive brown to dark brown with dark seams; the lower shell (plastron) is hinged, front and rear, and yellow to brown. Long barbels are typically present on the chin, and all four feet are webbed.

Taxonomy

This sub-species is recognized by Society for the Study of Amphibians and Reptiles (SSAR) as a valid taxon (Crother 2008, p. 71). This is based upon Iverson’s (1981, p. 18) description of the sub-species established on a set of 19 shell measurements. It appeared to be distinctive from the nominate race based on a long femoral scute, short anal scute, wide first vertebral scute, and narrow gular scutes (Iverson 1981, pp. 43-44). Results from a population genetics study indicate that the Quitobaquito/Rio Sonoyta populations are distinct from all other Arizona-New Mexico populations of *K. sonoriense*, which is consistent with the taxonomy developed by Iverson (1981, p. 27; Rosen 2003, p. 13). Based upon a careful review of the available taxonomic

information and its recognition as a valid taxon by SSAR (Crother 2008, p. 71), it is concluded that the Sonoyta mud turtle is a valid taxon.

Habitat/Life History

Sonoyta mud turtles are found both in the pond and stream channel at Quitobaquito Springs in Organ Pipe Cactus National Monument (OPCNM). Adults are typically captured in the deeper sections of the pond near dense stands of tules and other vegetation. Juveniles and sub-adults are found along the stream channel under overhangs and dense clumps of grass (Rosen and Lowe 1996a, p. 11). Sonoyta mud turtle habitat should include the mosaic of aquatic environments discussed above; but also basking sites for thermal regulation, and a combination of vegetated and vegetation free shoreline to provide cover sites and nesting substrates, respectively. In addition, shorelines must be accessible from aquatic environments to provide easy access to terrestrial habitat features of the Sonoyta mud turtle. The sub-species feeds primarily on aquatic invertebrates and plants, although fish and other vertebrates are also eaten (Hulse 1974b, p.197). Sonoyta mud turtles become mature at 3-4 years, and live as long as 25 years. Females deposit an average of 1.5 clutches per year with an average of four eggs per clutch from July-September, buried in soil on land (Rosen and Lowe 1996a, p. 21).

Historical Range/Distribution

The Quitobaquito / Rio Sonoyta region of southwestern Arizona and northwestern Sonora, Mexico is characterized by an extremely arid climate and isolation from other flowing water environments (Colorado and Gila rivers, and Rio Concepcion). Isolation of the Rio Sonoyta drainage probably occurred sometime in the last 100,000 years when eruptions from the Pinacate Volcanic Field diverted flow of the Rio Sonoyta southward to the Gulf of California, resulting in several endemic animal taxa from this aquatic system; including the Sonoyta mud turtle. This sub-species historically occurred throughout the Rio Sonoyta watershed where surface water was present.

Current Range/Distribution

The Sonoyta mud turtle occurs in only one locality in the United States at Quitobaquito Springs in OPCNM, Arizona, and in one stream, the Rio Sonoyta, and one spring, Quitovac, in Sonora, Mexico (Rosen 2003, pp. 2-5). Sonoyta mud turtles have been documented at seven sites in Mexico (Paredes-Aguilar and Rosen 2003, p. 5; Rosen 2003, pp. 2-5). Six of those sites are reaches found along the Rio Sonoyta; the seventh site is a pond (lagoon) fed by a set of four springs at Quitovac, southeast of town of Sonoyta. The majority of the Rio Sonoyta population sites are within or near the town of Sonoyta where pools are present for most or all of the year. One Sonoyta mud turtle was found several kilometers downstream in a short intermittent reach, and there is a small, thriving population at the 2-3 kilometers (km) (1.2-1.9 miles (mi)) long Papalote Reach of the Rio Sonoyta south of Quitobaquito. The population at Quitovac might represent an introduced population, as there are no aquatic migratory pathways between Rio Sonoyta and Quitovac, or it could be a long-isolated relict (Paredes-Aguilar and Rosen 2003, p. 10).

Population Estimates/Status

The Sonoyta mud turtle was once abundant at Quitobaquito Springs, but the population declined from probably several hundred in the 1950s to less than 100 in the late 1980s. Juvenile

survivorship has increased in recent years; population estimates in 1995 were about 130 individuals (Rosen and Lowe 1996a, pp. 19-21), and more recently, 134 in 2002 (AGFD unpublished data 2002). The Quitobaquito monitoring (2001-2006) documented a decline in population size from 2002 to 2003, with the populations stabilizing or with a slight increase occurring between 2005 and 2006, based upon within-year population estimates (NPS 2007, p. 3). In addition, a large number of young-of-year Sonoyta mud turtles captured in 2005 and 2006 indicate potential for future population increases (NPS 2007, p. 4). In 2007, the population monitoring was interrupted due to a need to translocate individuals to a refuge site in response to an unexpected drop in water level at Quitobaquito pond, so no new population estimates have been generated since 2006.

On October 30, 2007, 13 juveniles, subadults, and adults were translocated to the Arizona-Sonora Desert Museum (ASDM), Tucson, Arizona, for this purpose. Unfortunately, a raccoon gained access to the ASDM's Sonoyta mud turtle pens and killed 12 of the 13 individuals. The remaining individual was placed in a more secure location. In addition, five adult individuals were found dead during this time period. A necropsy was performed by the U.S. Geological Survey National Wildlife Health Center, Madison, Wisconsin, on one of the dead male Sonoyta mud turtles. Initial results found two principle abnormalities in this male Sonoyta mud turtle: effusion (fluids) in the body cavity and severe depletion of fat reserves (Holm 2007, p. 1). Both abnormalities are non-specific changes that could have multiple causes. No evidence of infectious disease was found in the Sonoyta mud turtle. Even though the individual appeared starved, there was food in its stomach and intestine.

In 2008, water levels in the pond continued to drop through the first half of the year. The water level reached an all time low of below minus 23.25 in. These water levels were low enough that standard population monitoring was not possible. On April 22, 2008, 31 individuals were captured by hand and transported to The Phoenix Zoo as part of a refuge population (NPS 2008, p. 3). One individual died in captivity at The Phoenix Zoo. The remaining 30 individuals were transported to the ASDM's newly secured Sonoyta mud turtle pens in February 2009. In 2009, large volumes of water were lost from Quitobaquito pond over a short period of time, providing evidence of one or more leaks in the pond. On August 20, 2009, 37 individuals were captured and transported to the ASDM's secure Sonoyta mud turtle pens (NPS 2009, p. 18). Two individuals died in captivity at ASDM. The refuge population at ASDM now consists of a total of 66 individuals. These animals will be repatriated after Quitobaquito pond has been reestablished, stabilized, and no further intrusive work is needed in Sonoyta mud turtle habitat. We anticipate this will occur in 2010.

In Mexico, the sub-species inhabits an intermittent reach of the Rio Sonoyta approximately 2-4 km (1.2-2.5 mi) upstream of the town of Sonoyta, an ephemeral dam pool and a sewage lagoon near the town of Sonoyta, and a reach that begins some 15 km (9.3 mi) downstream of the town of Sonoyta intermittently near Santo Domingo, continuing for several km through a perennial reach in the northwestern corner of the Reserva de la Biosfera el Pinacate y Gran Desierto de Altar (Pinacate) (Rosen 2003, pp. 2-5). A new population was discovered in March 2002 at Quitovac, Mexico, an approximate 2 ha (5 ac) spring complex approximately 40 km (25 mi) southeast of the town of Sonoyta (Knowles *et al.* 2002, p. 72). The size of the Quitovac population is estimated at about 200 individuals (Rosen 2003, p. 5). Rosen (2003, pp. 5-6)

estimates the combined population size to be 1,200 individuals (range 600-2700).

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Quitobaquito is a dredged and impounded pond fed by springs and seeps in nearby granite outcrops. Flow from springs may have been connected to the Rio Sonoyta via surface flows in recent times, but is now separated by approximately 1.5 km (.9 mi) of Sonoran Desert and Mexico Highway 2. The effects of the original dredging and impoundment on the Sonoyta mud turtle are unknown. However, the imperiled status of the Sonoyta mud turtle was apparently unknown to National Park Service personnel for many years. The pond at Quitobaquito Spring was drained twice to eliminate non-native fish and enhance habitat for the endangered desert pupfish (*Cyprinodon macularius*). During these drying episodes many Sonoyta mud turtles were collected and given away as pets (Rosen 1986, p. 17). The National Park Service has since recognized the unique nature of the Sonoyta mud turtle population and has become sensitive to its management needs. They have also identified habitat features such as basking sites, banks free of vegetation, access to terrestrial habitats, and pools in the inlet channel, that are becoming less available to the subspecies. The National Park Service is working to maintain these habitat features and improve habitat heterogeneity. In 2006, the water level in the pond at Quitobaquito Spring reached an all time low in June prior to the rains. In an effort to increase the discharge rate from Quitobaquito Spring, OPCNM staff reconstructed the leach field below the springhead through trenching, and replacing the existing gravel and perforated pipe in April 2007 (Pate 2007, p. 1). From September to October 2007, the pond reached its lowest recorded water level, 59.06 cm (23.25 inches) below the overflow pipe (Tibbitts 2007a, p. 1). This resulted in an estimated 70% reduction in surface area and an average depth of about 11.4 cm (4.5 inches). To improve access to the structures at Quitobaquito Springs, OPCNM staff removed the dead vegetation around the pond, and trimmed the aquatic vegetation and improved the pools along the stream channel (Tibbitts 2007b, p. 1).

In March 2008, water levels began to drop again. A small “turtle moat” was created that captured the water coming from the spring channel. In April and May 2008, the National Park Service removed several decades of tree growth on the retaining berm and installed a “diaphragm wall” down the center of Quitobaquito pond’s retaining berm (NPS 2008, p. 4). This diaphragm wall was constructed with a plastic liner and dry cement fill placed in a 1 foot wide and 5.5 to 6 ft deep trench down the center of the retention berm. After the completion of the diaphragm wall, the water remained at an all time low of minus 28.5 inches (or 28.5 inches below the outflow pipe) (NPS 2008, p. 5). More than 83,500 gallons of water were hauled to Quitobaquito pond during July and August to maintain the existing level of habitat. The delayed monsoon rains raised the pond level 3.5 inches in late August and early September (NPS 2008, p. 5). By the end of 2008, water levels increased through a combination of spring input, water hauling, and precipitation events to minus 19.5 inches (NPS 2008, p. 5).

During winter 2008-2009, OPCNM staff removed extensive growths of bulrush, which had encroached toward the pond center since water levels had dropped. Following these efforts and to test whether the leak persisted, additional water was trucked to the pond during March 2009, achieving the highest water level in the pond since mid-September 2007. By April 2009, falling

water levels indicated the leak was still present (the lowest level reached in 2009 was minus 27.5 inches). In the summer of 2009, approximately 4,500 ft² of the southeastern corner of the pond was isolated by constructing a temporary coffer dam. All possible Sonoyta mud turtles were removed for temporary safekeeping offsite. The southeastern corner was then emptied of water, mud, and detritus. The retaining berm was widened inward approximately 4 feet, using compacted clean fill material. A bentonite wall was built into the center of this enlargement of the berm. Finally, the pond bottom was covered with about 6 inches of compacted bentonite and fill mixture. In early December 2009, the total rise in water level since the southeastern corner renovation was 10.25 inches (the pond level was minus 13.7 inches), with no rain, relatively low spring input, and above-average temperatures much of that time, suggesting the renovation plugged a leak in the berm. Rain events in January 2010 increased the pond level to about minus 6 inches (T. Tibbitts pers. comm. April 7, 2010); however, in February 2010, the level of Quitobaquito pond fell to minus 12.1 inches (electronic mail from T. Tibbitts, February 10, 2010). As of early April 2010, the level is holding steady at minus 12.5 inches which indicates one remaining leak is controlling the pond at that level. The large leaning cottonwood tree is the leading candidate for the remaining leak and later in 2010 OPCNM will attempt to seal around this tree.

Additional threats to Quitobaquito pond and springs include high levels of cross-border violator (CBV) and U.S. Border Patrol (USBP) activities in the immediate area. To date this has not been documented, although CBVs could damage the pond or springs and surrounding area or contaminating the pond or springs. USBP or other vehicles have driven several times recently on the berm that impounds Quitobaquito pond. Evidence of driving on the berm was noted in an OPCNM database on May 13, 2008; November 20, 2008; March 4, 2009; June 11, 2009; September 4, 2009; and October 7, 2009; however, staff have also informally observed tracks about 10-15 times in the last two years. The tracks often show tread types characteristic of USBP vehicles, although other unauthorized vehicles have likely driven on the berm as well (T. Tibbitts pers. comm. 2009). OPCNM has recently constructed wooden fence at the western and eastern ends of the berm to discourage vehicle traffic. Vehicle activity on the berm could cause its partial collapse or deterioration. If the integrity of the berm is compromised, much or all of the pond could be lost if the berm collapses. Even if the berm does not collapse, driving on it could cause deterioration, resulting in materials spilling into the pond, decreasing its volume, reducing habitat for Sonoyta mud turtle, and requiring additional work to repair and reinforce it. Additionally, vehicles could slide into the pond, either due to collapse of the berm or driving too close to the edge followed by accidental slippage off the berm and into the pond. Contaminants in the form of oil or other vehicle fluids could cause damage Sonoyta mud turtle habitat.

Additionally, as was documented in October 2009, vehicles could drive over the stream crossing that connects the springs to the pond. The stream flows through an artificial concrete channel designed by the Arizona-Sonora Desert Museum in 1989 to create habitat for mud turtles, while supplying a dependable flow of water to the pond. Though no significant damage was sustained from this recent incident in which a USBP agent drove over the channel several times in an ATV, such events could affect the flow of water from the spring to the pond. If the concrete channel was broken or damaged, water could be diverted from the channel, resulting in dewatering of the spring channel and possible lowering or drying of the pond.

The future of Quitobaquito pond and springs depends heavily on OPCNM's ability to manage the site, which is currently affected by the threat posed by high levels of CBV activities along the border at OPCNM (i.e., OPCNM biologists and staff cannot freely visit the site to conduct management, maintenance, and monitoring, as they must be accompanied by law enforcement on all visits). If CBV activities decrease in the area, OPCNM's ability to manage Quitobaquito will improve.

Rio Sonoyta is a disjunct stream of the Colorado River system that was likely isolated in the Pinacate Region during a volcanic activity period in the Pleistocene (Ives 1936, p. 349). The Sonoyta mud turtle's aquatic habitat in the Rio Sonoyta is being lost and degraded due to groundwater pumping, and is subject to livestock grazing, urbanization, and pesticide application (McMahon and Miller 1982, p. 242; Hendrickson and Varela-Romero 1989, p. 481; Brown 1991, p.48; Rutman 1997, pp. 4-5), although these latter impacts may not have major effects on the turtle. Increases in the amount of groundwater withdrawal, changes in wastewater treatment, or introduction of non-native crayfish (e.g., northern crayfish *Orconectes virilis*, or red [Louisiana] swamp crayfish *Procambarus clarkii*), bullfrogs (*Rana catesbeiana*) and/or large predaceous fish to the Rio Sonoyta could result in extirpation of the subspecies from this system.

Salt cedar (*Tamarix ramosissima*) has become established along the Rio Sonoyta (Paredes-Aguilar and Rosen 2003, p. 7-8). It also poses a threat at Quitobaquito but currently is being aggressively and successfully controlled by OPCNM (T. Tibbitts pers. comm. April 7, 2010). It is a high water use plant, and may utilize valuable water resources during dry periods. Although saltcedar uses water heavily in the dense thickets in which it exists at Rio Sonoyta, its roots stabilize the stream banks and provide hard shelter protecting turtles against predator and flood. Bufflegrass (*Pennisetum ciliare*) and Sahara mustard (*Brassica tournefortii*) have become established along the Rio Sonoyta. In addition to altering the native plant composition, the presence of non-native vegetation increases the potential for wildfire (both frequency and intensity). Large, intense fires could potentially increase siltation within the stream system and degrade the watershed.

B. Overutilization for commercial, recreational, scientific, or educational purposes. The subspecies has been illegally collected at Quitobaquito (Rosen and Lowe 1996b, p. 9), but the extent of this activity is unknown, but it is occurring (Ami Pate, pers. comm. 2007). Collecting pressure in the Rio Sonoyta is also unknown. Because of low population sizes and reproductive potential, any collecting, particularly of adult female turtles, could be critical to local population viability.

C. Disease or predation. No non-native predators capable of consuming Sonoyta mud turtles or their eggs are known from Quitobaquito or the Rio Sonoyta, with the exception of feral and domestic cats and dogs in and near the town of Sonoyta. Introduction of non-native bullfrogs is a potential threat. Bullfrogs are known to prey on turtles and may be capable of impacting populations of mud turtles. Likewise, non-native crayfish are known to prey on the Sonoran mud turtle (Schwendiman 2001, p. 39) and their introduction was closely correlated with marked population reductions at the one Arizona locality that has been evaluated (Fernandez and Rosen 1996, pp. 40-41). Concern has also been expressed over possible nonnative fish introduction into Quitobaquito. Some non-native species, such as largemouth bass (*Micropterus salmoides*),

are likely capable of preying on mud turtles (Paul Stone, pers. comm. 2009); however, largemouth bass are not known from any of the habitats currently supporting the Sonoyta mud turtle. Additionally, mosquitofish and black bullhead (*Amieurus melas*) occupy the Rio Sonoyta (Hendrickson and Varela-Romero 1989, pp. 479-480). In October 2003, a tilapia was reported in the Rio Sonoyta (Service unpublished data 2003) and a form of Tilapia is established at Quitovac. Although these non-native species are not considered a threat to the Sonoyta mud turtle, they may have some adverse affects on the native fish fauna in the Rio Sonoyta, the endangered Quitobaquito pupfish (*Cyprinodon eremus*) and longfin dace (*Agosia chrysogaster*).

Individuals of several species of non-native turtles have been documented in Quitobaquito. Smith and Hensley (1957, pp. 201-202) collected a mating pair of yellow mud turtles in 1955, originally described as *K. flavescens stejnegeri*, which was later subsumed into *K. flavescens arizonense* by Iverson (1979, p. 176). These can compete for limited resources, introduce disease and parasites currently not known in the Sonoyta mud turtles, and potentially prey on hatchlings. This species may have been native on the Rio Sonoyta floodplain, but thrives in ephemeral, rather than perennial water; thus, although it is not a likely threat under current conditions, it will likely replace the Sonoyta mud turtle as waters become increasingly non-perennial. The Arizona mud turtle has recently been documented photographically at Presa Xochimilco, Sonoyta (Ami Pate, pers. comm.. 2007) and from just north of OPCNM (Peter Holm, pers. comm.. 2009). No non-native turtle species have been documented in the Rio Sonoyta, but released pet turtles and potential competition for resources will be an on-going issue within the Rio Sonoyta basin.

D. The inadequacy of existing regulatory mechanisms. In Arizona, the Sonoyta mud turtle is considered a “Tier 1a Species of Greatest Conservation Need” in the Arizona Game and Fish Department (AGFD) document, Arizona’s Comprehensive Wildlife Conservation Strategy (CWCS) (AGFD 2006a, p. 32 and p. 490). Arizona state law still allows collection of Sonoyta mud turtles with an annual bag limit of four, live or dead, under the species level taxon. Protection to individuals and their habitat is provided by the only known location in Arizona being within OPCNM. The National Park Service requires special permitting for any collections of this sub species and the habitat is fully protected. In Mexico, the Sonoyta mud turtle does not have protected status, nor is the habitat protected.

E. Other natural or manmade factors affecting its continued existence. A reduction in annual precipitation at OPCNM and a reduction in water levels in Quitobaquito Springs have been contributing factors to the drop in the population estimates since 2001, based upon earlier work by Rosen and Lowe (1996a, p. 24), which directly correlated precipitation with recruitment (Rosen *et al.* 2006, p. 4). This relationship may be related to impacts of drought on terrestrial vegetation, spring output, and evaporation rate as they impact turtle food supply and egg survival during drought (Rosen *et al.* 2006, p. 4). In addition, this population of Sonoyta mud turtles has been shown to be under some nutritional stress, based upon a lack of stored lipid reserves (fats) (Rosen and Lowe 1996a, pp. 31-32; Rosen *et al.* 2006, p. 6; Holm 2007, p. 1). Aquatic habitat in the Rio Sonoyta is extremely dynamic due to climatic extremes (Ives 1936, pp. 352-354; Hendrickson and Varela-Romero 1989, p. 482). Sonoyta mud turtle populations are likely reduced due to this dynamic nature. Because turtle populations have a low intrinsic population growth rate, they are incapable of expanding rapidly to take advantage of temporary habitats

created by periods of high precipitation, but populations can decline rapidly during drought years. Also, populations of Sonoyta mud turtles are relatively small. Small populations are vulnerable to environmental and demographic random events, which increase the probability of extinction (Lande 1993, p. 923).

Between 1989 and 1993, U.S. Fish and Wildlife Service contaminants biologists' analyzed Sonoyta mud turtles found dead by Rosen and Lowe (1996a, p. 29), and also analyzed pond sediments from Quitobaquito Springs. They found that Sonoyta mud turtles from Quitobaquito Springs exhibited very low body lipid reserves, which indicated a possible dietary deficiency and starvation. In 2007, the U.S. Geological Survey National Wildlife Health Centers (Madison, Wisconsin) initial necropsy results had the same findings (Holm 2007, p. 1). The U.S. Fish and Wildlife Service contaminants biologists' also found relatively high levels of boron, chromium, selenium, strontium, and zinc in Sonoyta mud turtle tissues. High levels of these contaminants combined with low availability of protein rich foods may be limiting turtle survival (King *et al.* 1996, p. 5). Low lipid reserves may also result in reduced egg production. Pesticide use in agricultural lands along the Rio Sonoyta may contaminate habitats of the turtle. For example, low levels of DDE metabolites and Dacthal, an herbicide, were found in mud turtles from Quitobaquito since 1981 (King *et al.* 1996, p. 3; Rosen and Lowe 1996a, pp. 30-31). The effects of such pesticides on this species are unknown. Thus, contaminants are a potential threat to the sub-species.

The stretch of Rio Sonoyta flowing through the town of Sonoyta is subject to various sewage effluents. Sewage effluent released from a military complex located above Presa Xochimilco once created large perennial pools within the Rio Sonoyta streambed at the upper end of the Presa Xochimilco. In 2008, the effluent bypassed Presa Xochimilco, and was piped to the wastewater treatment facility in the town of Sonoyta. These pools are now reliant only on stormwater runoff and may no longer be perennial. Despite the obvious detrimental effects such as chemical pollutants and nutrient loading, these pools provided habitat for Sonoyta mud turtles during the frequent periods when the stream is otherwise dry, and this was the largest known population of the subspecies. It has not been checked on since the water source was diverted. On the west side of the town of Sonoyta, there is a sewage lagoon that is greater than 5 ha (greater than 12 ac) that also drains into the Rio Sonoyta; Sonoyta Mud turtles are present in the lagoon. In addition to sewage, there is the potential for run-off from agricultural fields and livestock holdings (King *et al.* 1996, pp. 4-5). In 2007, the U. S. Fish and Wildlife Service, Arizona Ecological Services Field Sub-office, Tucson, Arizona reviewed a proposal to fund the construction of a new wastewater treatment facility east of the town of Sonoyta, funded through an Environmental Protection Agency (EPA) grant program. This proposed project could result in the decommissioning of the current wastewater treatment system and corresponding elimination of wastewater flow into the current sewage lagoon. This would likely cause the lagoon to dry and become unsuitable for Sonoyta mud turtles. Furthermore, the proposed project could result in the elimination of outflow from the current sewage lagoon into the Rio Sonoyta and diminished recharge of the shallow aquifer that contributes to the perennial Papalote Reach of the Rio Sonoyta downstream of the town of Sonoyta. In 2008, however, the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) issued a Resolutivo with binding conditions for the project to the water and wastewater utility of Sonoyta (the project proponent). These conditions include a requirement for the utility to negotiate an agreement with the Pinacate

Biosphere Reserve to 1) ensure all treated water from the new facility is returned to the Rio Sonoyta, 2) build a pond for Sonoyta mud turtles near the new facility, and 3) hire a biologist to oversee management of these measures. Construction of the new facility is expected to begin in 2010 but is pending agreement on the conditions specified in the Resolutive.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The Sonoyta mud turtle is considered a Tier 1a species in the AGFD Comprehensive Wildlife Conservation Strategy: 2005-2015 (AGFD 2006, p. 490). The AGFD was awarded with a section 6 grant from the U.S. Fish and Wildlife Service to develop a Conservation Agreement for the Sonoyta mud turtle. The Quitobaquito / Rio Sonoyta Working Group (QRSWG) was formed in 2001 with the agencies and interested parties in the United States and Mexico to assist in development of a conservation strategy and agreement for the species. The U.S. Fish and Wildlife Service is working with OPCNM about the status of and potential conservation measures for this sub-species. The Phoenix Zoo has expressed interest in propagating Sonoyta mud turtles and perhaps establishing a captive population on the zoo grounds. A mailing list has been prepared for the prenotification status summary and information letter. Contracts have been let to Phil Rosen, University of Arizona, and Centro de Estudios de Estado y Sociedad (CEDES) (formerly Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora or IMADES), Hermosillo, Sonora, to define the status and distribution of the Sonoyta mud turtle in Sonora, Mexico. A proposal, submitted by J. Daren Riedle and Richard Kazmaier of West Texas A&M University, to conduct complete demographic and population viability analyses (PVA) based on more than two decades worth of Sonoyta mud turtle monitoring at OPCNM was approved by OPCNM in 2008. For the PVA, they used four, 3-stage models based on female survivorship (Riedle and Kazmaier 2009, p. 4). All simulations were set to run 1000 replications for 50 time steps (50 yr). Model 1 simulated conditions based on 2001-05 data. The population was set at 65 and divided between 3 age classes. Model 2 was a recovery based-model with a starting population of only the 13 females being held in an offsite assurance colony. In Model 3, they simulated the effects of doubling the number of adult females in the assurance colony. Model 4 simulated the effects of adding 10 individuals from younger age classes to animals already held within the assurance colony. Based on the results of model 1, the population of Sonoyta mud turtles at Quitobaquito appears stable if not slightly growing (Riedle and Kazmaier 2009, p. 5). While Models 2-3 do demonstrate likelihood of recovery by using only adult turtles, total estimated population size remains low. Of more concern is the probability of a population-halving event occurring when Models 2 and 3 were compiled. With the addition of just five pre-reproductive turtles in both pre-reproductive age classes in Model 4, estimated population sizes doubled and the probability of the population halving was reduced to zero, as compared to those in Model 2. Based on iterations within Model 4, the smallest viable population to return a zero extinction risk was 24 individuals. In conclusion they report that maintaining reproduction and juvenile survivorship is important to the persistence of this population (Riedle and Kazmaier 2009, p. 6). Their Population Viability Models also support the importance of juvenile females to this population, particularly when dealing with assurance colonies and reintroductions. By increasing the number of females and age classes represented, the estimated minimum abundance of the Quitobaquito population was doubled.

SUMMARY OF THREATS: The Sonoyta mud turtle is faced with the present and threatened destruction, modification, or curtailment of its habitat or range from continued drought

throughout its current range, and continued surface and ground water withdrawal. Along the Rio Sonoyta, present activities that could constitute threats include livestock grazing, urbanization, and establishment of salt cedar within the riparian zone. Future threats from changes in wastewater treatment and effluent release could severely reduce the available water in the Rio Sonoyta. The establishment of non-native, invasive upland plants within the watershed increases the potential for wildfire (both frequency and intensity), and potentially increase siltation within the stream system and further degrade the watershed. Illegal collection of the subspecies has been documented at Quitobaquito Spring (Rosen and Lowe 1996b, p. 9), but the extent of this activity is unknown, along with collecting pressure in the Rio Sonoyta. Illegal collecting (particularly of adult females) could be critical to population viability due to low population sizes and reproductive potential. In Quitobaquito and Rio Sonoyta, only feral and domestic cats and dogs are known to be capable of consuming the subspecies or their eggs. A potential threat exists from the introduction of non-native bullfrogs, crayfish, and/or predatory fish throughout the subspecies' range. Current drought cycles and the reduction in annual precipitation at OPCNM continue to be an immediate threat to the subspecies. This drought, coupled with a corresponding reduction in water levels in Quitobaquito Springs pond have been contributing factors to the drop in the population estimates since 2001 (Rosen *et al.* 2006, p. 4). In addition, this population of Sonoyta mud turtles has been shown to be under some nutritional stress, based upon a lack of stored lipids (Rosen and Lowe 1996a, pp. 31-32). Aquatic habitat in the Rio Sonoyta is extremely dynamic due to climatic extremes (Ives 1936, pp. 352-354; Hendrickson and Varela-Romero 1989, p. 482). Sonoyta mud turtle populations are likely reduced due to this dynamic nature. Because turtle populations have a low intrinsic population growth rate, they are incapable of expanding rapidly to take advantage of temporary habitats created by periods of high precipitation, but populations can decline rapidly during drought years. Also, populations of Sonoyta mud turtles are relatively small and are vulnerable to environmental and demographic random events, which increase the probability of extinction (Lande 1993, p. 923). Thus, we find that this sub-species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

___ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES

- Secure and maintain all Sonoyta mud turtle habitat occurring within OPCNM.
- Improve habitat occurring along the Rio Sonoyta within boundaries of the Pinacate Biosphere Reserve in Sonora, Mexico.
- Reduce and remove threats from the populations in Mexico.
- Collaborate with and assist Mexican and U.S. EPA efforts to reconcile conservation of the Sonoyta mud turtle with modernization of the public health infrastructure and riparian parkland in and adjoining Sonoyta. Monitor the status of these efforts underway with town of Sonoyta, Pinacate, SEMARNAT, CEDES, EPA, and OPCNM.
- Establish and maintain refuge populations.

- Monitor all populations of Sonoyta mud turtles and appropriate management practices to maintain or increase existing population numbers.
- Conduct research that investigates the ecology of and threats to the Sonoyta mud turtles.
- Increase local awareness of the unique resources of the Rio Sonoyta and increase community involvement in the conservation of these resources

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3*
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: The primary threat to the Sonoyta mud turtle is water development and its limited distribution. One small population occurs in the United States, in a pond less than an acre in size at Quitobaquito Springs, OPCNM. The pond at Quitobaquito Springs is being managed to maintain the existing habitat, as the pond is showing a community successional trend towards a vegetation choked wetland. Populations in Mexico are similar in scale: a population in the Rio Sonoyta exists in short perennial reaches totaling only a few kilometers in length, and a similarly sized population exists in a spring pool complex at Quitovac. Farming and development in the region continue to place demands on groundwater, and surface water amounts are very limited and likely to continue to decrease. The pond at Quitobaquito could be affected by hydrologic changes in the Rio Sonoyta (Carruth 1996, p. 22). The surface waters that this sub-species depends upon, both in the United States and Mexico, is highly dependent on land use and wastewater return flows. Changes in the current management of water resources of the Rio Sonoyta drainage could potentially result in extinction of the sub-species.

Imminence: The Sonoyta mud turtle is highly aquatic (Hulse 1974b, p. 195; Rosen and Lowe 1996, p. 5). Irrigated agriculture is widespread in the Rio Sonoyta Valley, and continued development in the towns of Sonoyta and Lukeville is placing increased demands on limited water supplies (Brown 1991, pp. 48-49). This combined with the current drought cycle in this

region has resulted in decreased surface water in the Rio Sonoyta and Quitobaquito Spring pond. In addition, Quitobaquito Spring discharge has decreased since the mid-1990s, and it is currently just over half of what it was in the 1970s. Water availability is also dependent on the use of wastewater in the town of Sonoyta, which at present is largely returned to the river untreated. These small remnant populations could be rapidly eliminated by surface and ground water withdrawal and changes in the treatment of wastewater.

_____ Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? Yes

Is Emergency Listing Warranted? No. Population estimates of the United States population of Sonoyta mud turtles indicate that it is down from historical population levels and a drought related decline was documented in 2001. Population estimates in 2006, indicate a low, but stable population. However the early estimates (1950's – 1970's) were based upon relatively small sample sizes (Rosen and Lowe 1996a, p. 21; Rosen *et al.* 2006, p. 3-6). In 2007, the sudden drop in water level at Quitobaquito pond resulted in a need to salvage individuals from the pond and create a refuge population in the United States. Because of the loss of available habitat due to drought in 2007-09 and prior declines in population size documented in correlation to drought, it is anticipated that the population in the United States has declined, but no population estimates are available for 2007-09. Recent pond repairs and rainfall events have improved habitat conditions for the Sonoyta mud turtle at Quitobaquito, however a population estimate survey will only be carried out if conditions allow (i.e., if pond levels rise further). Unless estimates are conducted, we will not be able to determine if improved habitat conditions at Quitobaquito are resulting in an increased Sonoyta mud turtle population. While monitoring of the Mexico population in 2001-2004 indicated a stable population, the potential loss of habitat due to the loss of the effluent inflows from the military complex is likely to result in a corresponding loss of individuals similar to those experienced during drought. The populations at Quitovac, the Sonoyta wastewater treatment plant, and the Papalote reach of the Rio Sonoyta are currently presumed relatively stable. This said, proposed changes to the Sonoyta wastewater treatment plant could adversely affect the populations at the Sonoyta wastewater treatment plant and the Papalote reach of the Rio Sonoyta. However, binding conditions for the project required by SEMARNAT should help minimize these impacts. Drought has severely affected the Papalote Reach, and for the first time in 2007 sampling recorded no evidence of reproduction. While these populations remain threatened by their small size and limited distribution, current information, primarily pro-active conservation actions in both the U.S. and Mexico, does not suggest that emergency listing is warranted.

DESCRIPTION OF MONITORING: Monitoring is being conducted by the University of Arizona, U.S. Fish and Wildlife Service, AGFD, CEDES, OPCNM, and Pinacate. With the exceptions explained above (i.e., that no monitoring has occurred at Quitobaquito since 2006; and none since 2007 in Mexico) monitoring is generally done annually and in some cases biannually in the United States and Mexico. Methods consist of trapping Sonoyta mud turtles, measuring, aging, sexing and marking. Monitoring data can be used to generate Jolly-Seber and Chapman version of the Lincoln-Peterson Index type statistical population estimates.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Arizona; the Sonoyta mud turtle is included in Arizona's Comprehensive Wildlife Conservation Strategy.

Coordination occurs through the informal Quitobaquito/Rio Sonoyta Working Group, which meets annually. Membership includes:

Arizona:

- Arizona Game and Fish Department
- University of Arizona

Sonora, Mexico:

- Comision de Ecologia y Desarrollo Sustentable del Estado de Sonora (CEDES)
- Reserva de la Biosfera el Pinacate y Gran Desierto de Altar (Pinacate) Federal:
- National Park Service – Organ Pipe Cactus National Monument
- U.S. Fish and Wildlife Service- Arizona Ecological Services Office

Indicate which State(s) did not provide any information or comments: NA


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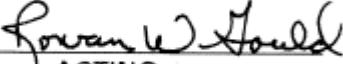
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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  May 21, 2010
Acting Regional Director, Fish and Wildlife Service Date

Concur: 
ACTING :
Director, Fish and Wildlife Service Date: October 22, 2010

Do not concur: _____
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review: May 2010

Conducted by: Erin Fernandez